VIII.3 Fuel Cell and Hydrogen Research (New Project)*

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**Congressionally directed project*

Objectives

- Improve promising thermochemical, photo-electrochemical and photocatalytic hydrogen production methods.
- Investigate storage of hydrogen in transition metal complex hydrides and porous nano-composite polymers that contain modified fullerene compounds and carbon nanotubes.
- Develop electrodes and Polymer Electrolyte Membrane (PEM) membranes that can operate reliably in the temperature range of 100-150^{o}C.

Technical Barriers

This project addresses the following technical barriers from the Hydrogen Production, Hydrogen Storage and Fuel Cells sections of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year Research, Development and Demonstration Plan:

Production

- V. High- and Ultra-High-Temperature Thermochemical Technology
- O. Photoelectrochemical Efficiency
- G. Efficiency of Gasification, Pyrolysis, and Reforming Technology

Storage

- N. Lack of Understanding of Hydrogen Physisorption and Chemisorption

Fuel Cells

- O. Stack Material and Manufacturing Cost
- Q. Electrode Performance

Approach

- Study and quantify the reactor kinetics of the cycle described as the University of Tokyo Cycle #3.
- Develop nano-particle oxide supported catalysts for improvement of the biomass gasification process.
- Develop a tandem all thin-film solar cell based on a cadmium selenide and copper indium gallium selenide structure with a target open circuit voltage above 1.45 volts.
- Develop an electrolytic cell based on mixed sulphates and phosphates of cesium and barium to operate in the 100-150 ^{o}C range.
- Synthesize transition metal complex hydride, Mg_2FeH_6, by employing chemical and mechano-chemical processes and by doping it with Ti and Zr compounds and/or substituting Na/Li in the host structure.
- Improve the operating temperature of PEM fuel cells by pursuing a variety of materials concepts for the solid polymer electrolyte including, zeolites and Nafion/clathrate composite membranes.
- Catalytic improvement by doping electrodes with newly developed catalysts, such as Pt/Ru, Pt/Pd, Pt/Ag bimetallics.